

CLAIMS

What is claimed is:

1. A micro optical train manufacturing process, comprising:
installing optical components onto an optical bench to form an optical train;
5 measuring positions of the optical components of the optical train; and
aligning the optical components of the optical train in response to the determined
positions.
2. A process as claimed in claim 1, wherein the step of installing the optical
components comprises solder bonding the optical components to the optical bench.
- 10 3. A process as claimed in claim 1, wherein the step of installing the optical
components comprises eutectic solder bonding the optical components to the optical
bench.
4. A process as claimed in claim 1, wherein the step of installing the optical
components is performed by a precision placement and bonding machine.
- 15 5. A process as claimed in claim 1, wherein the step of installing the optical
components is performed in a solder reflow oven.
6. A process as claimed in claim 1, further comprising characterizing an optical
property of at least some of the optical components prior to installing the optical
components on the optical bench.
- 20 7. A process as claimed in claim 6, wherein the step aligning the optical components
of the optical train is further performed in response to the determined optical property.

8. A process as claimed in claim 1, further comprising determining focal lengths of at least one of the optical components prior to installing the optical component on the optical bench.

5 9. A process as claimed in claim 1, further comprising assembling optical components prior to attaching the optical components on the optical bench.

10. A process as claimed in claim 9, wherein the step of assembling the optical components comprises solder bonding optical elements to mounting structures.

11. A process as claimed in claim 9, wherein the step of assembling the optical components comprises thermally bonding optical elements to mounting structures.

10 12. A process as claimed in claim 1, wherein the optical components are installed on the optical bench to a precision of less than 4 micrometers.

13. A process as claimed in claim 1, wherein the optical components are installed on the optical bench to a precision of less than 1 micrometer.

15 14. A process as claimed in claim 1, wherein the step of determining the positions of the optical components comprises determining positions of the optical components relative to reference marks on the optical bench.

15. A process as claimed in claim 1, wherein the step of determining the positions of the optical components comprises determining distances between the optical components.

20 16. A process as claimed in claim 1, wherein the step of determining the positions of the optical components is performed by a vision system by reference to predetermined features of the optical components.

17. A process as claimed in claim 1, wherein the step of determining the positions of the optical components comprises determining positions of optical elements of the optical components.

5 18. A process as claimed in claim 1, wherein the step of determining the positions of the optical components comprises determining positions of mounting structures of the optical components.

19. A process as claimed in claim 1, wherein the step of aligning the optical components comprises passively aligning the optical train.

10 20. A process as claimed in claim 1, wherein the step of aligning the optical components comprises plastically deforming the optical components.

21. A process as claimed in claim 1, further comprising, after aligning the optical components in response to the determined positions, actively aligning the optical components of the optical train.

15 22. A process as claimed in claim 21, wherein the step of actively aligning the optical components comprises deforming the optical components.

23. A process as claimed in claim 1, further comprising, after aligning the optical components in response to the determined positions, transmitting an optical signal through the optical train and further aligning the optical components of the optical train in response to the transmission of the optical signal through the optical train.

20 24. A process as claimed in claim 23, wherein the step aligning the optical components in response to the optical signal comprises deforming the optical components.

25. A process as claimed in claim 23, wherein the step aligning the optical components in response to the optical signal comprises deforming mounting structures of the optical components.

5 26. A process as claimed in claim 23, wherein the step aligning the optical components in response to the optical signal comprises aligning the optical components to maximize a level of the optical signal that is transmitted through the optical train.

10 27. A process as claimed in claim 23, wherein the step aligning the optical components in response to the optical signal comprises aligning the optical components to maximize a side mode suppression ratio of a tunable optical filter in the optical train.

15 28. A process as claimed in claim 1, further comprising characterizing a position of an optical element on mounting structure of the optical components prior to installing the optical components on the optical bench by reference to light that is transmitted through the optical element.